

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-107748

(43)Date of publication of application : 10.04.2002

(51)Int.Cl. G02F 1/1343
G02F 1/1337

(21)Application number : 2000-296631

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(22)Date of filing : 28.09.2000

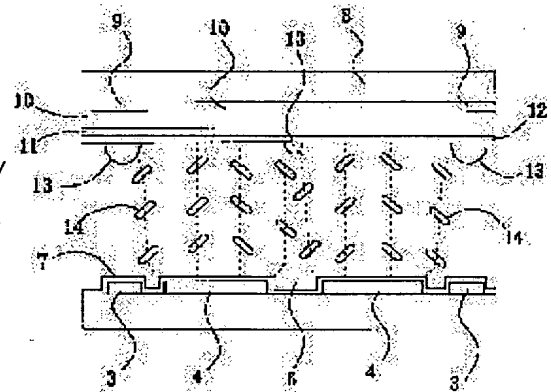
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(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a liquid crystal display device having a wide field angle where display unevenness like a burning phenomenon is prevented and plural domains are formed in one pixel.

SOLUTION: A first substrate 1 having a pixel electrode 4 and a second substrate 8 having a common electrode 11 are arranged so as to face each other, and liquid crystal 14 having negative dielectric constant anisotropy is held between both substrates 1 and 8, and both substrates 1 and 8 are coated with vertically oriented films 7 and 12, and liquid crystal molecules 14 are vertically arranged when an electric field is not applied to a liquid crystal layer, and they are obliquely arranged when it is applied to the liquid crystal layer. In this liquid crystal display device, the second substrate 8 is provided with projections 13 made of a conductor which regulates the inclination direction of liquid crystal molecules at the time of field application, and slits 6 are formed in the positions facing the projections 13 of the pixel electrode 4.



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CLAIMS

[Claim(s)]

[Claim 1]The first substrate in which a picture element electrode was formed in a pixel which arranges a signal wire and a scanning line characterized by comprising the following to matrix form, and is surrounded with said signal wire and said scanning line, The second substrate in which a common electrode was formed, and an orienting film which performed perpendicular orientation processing laminated on said both boards, A liquid crystal display which a liquid crystal element inclines and is arranged when permittivity anisotropy pinched among said both boards had a negative liquid crystal layer, a liquid crystal element carries out vertical arrangement when an electric field is not impressed to said liquid crystal layer, and an electric field is impressed to said liquid crystal layer.

A projection of a conductor which is provided in said second substrate and regulates a slope direction of said liquid crystal element.

A slit formed in said projection of said picture element electrode, and a portion which counters.

[Claim 2]The liquid crystal display according to claim 1 forming a means to supply said common electrode and same electric potential to said projection.

[Claim 3]The liquid crystal display according to claim 2 said projection extending continuously to an end of said second substrate, and electrically connecting it with said common electrode at said end.

[Claim 4]The first substrate in which a picture element electrode was formed in a pixel which arranges a signal wire and a scanning line characterized by comprising the following to matrix form, and is surrounded with said signal wire and said scanning line, The second substrate in which a common electrode was formed, and an orienting film which performed perpendicular orientation processing laminated on said both boards, A liquid crystal display which a liquid crystal element inclines and is arranged when permittivity anisotropy pinched among said both boards had a negative liquid crystal layer, a liquid crystal element carries out vertical arrangement when an electric field is not impressed to said liquid crystal layer, and an electric field is impressed to said liquid crystal layer.

A projection which is provided in said second substrate and regulates a slope direction of said liquid crystal element.

A dielectric constant which has said projection of said picture element electrode, and the slit formed in a portion which counters and in which said projection is higher than a dielectric constant of said liquid crystal layer.

[Claim 5]The liquid crystal display according to claim 1 to 4 which forming said projection in linear shape, and arranging almost in parallel with said signal wire.

[Claim 6]The liquid crystal display according to claim 1 to 4 which forming said projection in linear shape, and arranging almost in parallel with said scanning line.

[Claim 7]The liquid crystal display according to claim 1 to 4, wherein said projection is formed in zigzag shape.

[Claim 8]The liquid crystal display according to claim 1 to 4 arranging ranging over two picture element electrodes which said projection is formed in zigzag shape along said signal wire, and adjoin said scanning line direction.

[Claim 9]The liquid crystal display according to claim 1 to 4 arranging ranging over two picture element electrodes which said projection is formed in zigzag shape along said scanning line, and adjoin in said direction of a signal wire.

[Claim 10]The liquid crystal display according to claim 1 to 9, wherein said projection is formed on said orienting film.

[Claim 11]The liquid crystal display according to claim 1 to 10 in which a portion in which said projection exists is characterized by removing an orienting film on said second substrate.

[Claim 12]The liquid crystal display according to claim 1 to 11, wherein said slit is located in a center section of said picture element electrode at least.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the liquid crystal display of the wide viewing angle which provided two or more domains in 1 pixel.

[0002]

[Description of the Prior Art]Generally the feature of a thin light weight and low power consumption is shown in a liquid crystal display, and it is broadly used from a personal digital assistant to large-sized television. A TN type liquid crystal display is often used as this liquid crystal display, and performance high as a display and quality are maintained.

[0003]In the case of a TN type TFT (ThinFilm Transistor) liquid crystal display, it has arranged so that the substrate with which the picture element electrode was formed, and the substrate with which the common electrode was formed may be countered, and the liquid crystal is enclosed between the substrates of this couple. Orientation treatment is performed to the orienting film on both boards by rubbing etc., and the orientation direction is set up differ from the orientation direction of the substrate which counters 90 degrees. A liquid crystal element is regulated by this orientation direction, and horizontal arrangement is carried out in that direction, and between substrates, horizontally, it is twisted 90 degrees and arranges. Although a polarizing plate counters a substrate and is arranged at the outside of each substrate, at the time of normally black mode, it is arranged so that the transmission axis of both polarizing plates may become a uniform direction, and it is arranged so that the transmission axis of both polarizing plates may make 90 degrees at the time of a normally white mode. Although the transmitted light which passed one polarizing plate turns into linear polarization and a liquid crystal layer is passed, since the liquid crystal element was twisted 90 degrees at this time and it has arranged, the transmitted light circles and a polarization direction is twisted 90 degrees. At this time, in normally black mode, since the transmitted light which passed the liquid crystal layer cannot pass the polarizing plate of another side, it becomes a dark display, but since the transmitted light which passed the liquid crystal layer at the time of a normally white mode can pass the polarizing plate of another side, it serves as clear display.

[0004]However, there were problems, like TN liquid crystal displays have large visual angle dependency. Then, the liquid crystal display of a wide viewing angle IPS (In-Plane Switching) type or VA (verticallyaligned) type is proposed rather than TN type. A liquid crystal negative in permittivity anisotropy is enclosed between the substrates of a couple, a picture element electrode is arranged at one substrate, and, as for the VA type liquid crystal display, the common electrode is arranged at the substrate of another side. Perpendicular orientation processing is performed to the orienting film on both boards, and when not impressing voltage to an electrode, the liquid crystal element is carrying out vertical arrangement. A polarizing plate is arranged at the outside of both boards, and it is set up so that the transmission axis of both polarizing plates may intersect perpendicularly. And since the liquid crystal element between substrates is carrying out vertical arrangement while not impressing voltage to an electrode, the transmitted light of linear polarization which passed one polarizing plate passes a liquid crystal layer as it is, and is interrupted with the polarizing plate of another side. Since the liquid crystal element between substrates carries out horizontal arrangement when voltage is impressed to an electrode, the double reflex of it is carried out, and the transmitted light of linear polarization which passed one polarizing plate turns into a passing beam of elliptical polarization, when passing a liquid crystal layer, and passes the polarizing plate of another side.

[0005]In order to improve further the angle of visibility of such a liquid crystal display, there is the method of forming two or more domains in 1 pixel, and in order to form this domain, the projection and the slot are provided in the pixel. This is indicated for example, in the patent No. 2947350 gazette. For example, when providing a projection in the substrate side of another side, the black matrix and the light filter were formed in the substrate of another side, and the light filter etc. are covered with the common electrode. The projection of the prescribed pattern was formed on this common electrode, and the orienting film is laminated to the common electrode and the projection. This projection is formed with the dielectric which is an insulating material of a low dielectric.

[0006]

[Problem(s) to be Solved by the Invention]However, when providing a projection in a pixel, a projection will exist between a picture element electrode and a common electrode, but since that projection is formed with the insulator of the low dielectric, the voltage impressed to a liquid crystal layer by this projection falls. Although impurity ion is floating to the liquid crystal layer, when the projection of a low dielectric exists on a common electrode, impurity ion focuses and adheres to the projection, and the printing phenomenon of a display occurs. Thus, a projection will be

the cause and display failure will arise.

[0007]Then, an object of this invention is to prevent display unevenness, such as printing, and to provide the liquid crystal display of the wide viewing angle in which two or more domains were formed in 1 pixel.

[0008]

[Means for Solving the Problem]In order that this invention may solve an aforementioned problem, the invention according to claim 1, The first substrate in which a picture element electrode was formed in a pixel which arranges a signal wire and a scanning line to matrix form, and is surrounded with a signal wire and a scanning line, The second substrate in which a common electrode was formed, and an orienting film which performed perpendicular orientation processing laminated on both boards, Permittivity anisotropy pinched among both boards has a negative liquid crystal layer, when an electric field is not impressed to a liquid crystal layer, a liquid crystal element carries out vertical arrangement, and when an electric field is impressed to a liquid crystal layer, a liquid crystal display which a liquid crystal element inclines and is arranged is characterized by comprising the following:

A projection of a conductor which is provided in the second substrate and regulates a slope direction of a liquid crystal element.

A slit formed in a projection of a picture element electrode, and a portion which counters.

[0009]The invention according to claim 2 formed a means to supply a common electrode and same electric potential to a projection.

[0010]The invention according to claim 3 extends continuously to an end of the second substrate, and a projection electrically connects it with a common electrode at the end.

[0011]The first substrate in which a picture element electrode was formed in a pixel which the invention according to claim 4 arranges a signal wire and a scanning line to matrix form, and is surrounded with a signal wire and a scanning line, The second substrate in which a common electrode was formed, and an orienting film which performed perpendicular orientation processing laminated on both boards, In a liquid crystal display which a liquid crystal element inclines and is arranged when permittivity anisotropy pinched among both boards had a negative liquid crystal layer, a liquid crystal element carries out vertical arrangement when an electric field is not impressed to a liquid crystal layer, and an electric field is impressed to a liquid crystal layer, It has a projection which is provided in the second substrate and regulates a slope direction of a liquid crystal element, a projection of a picture element electrode, and the slit formed in a portion which counters, and a projection is formed with a dielectric which has a dielectric constant higher than a dielectric constant of a liquid crystal layer.

[0012]A projection is formed in linear shape and the invention according to claim 5 is arranged almost in parallel with a signal wire.

[0013]A projection is formed in linear shape and the invention according to claim 6 is arranged almost in parallel with a scanning line.

[0014]As for the invention according to claim 7, a projection is formed in zigzag shape.

[0015]A projection is formed in zigzag shape along a signal wire, and the invention according to claim 8 is arranged ranging over two picture element electrodes contiguous to a scanning line direction.

[0016]A projection is formed in zigzag shape along a scanning line, and the invention according to claim 9 is arranged ranging over two picture element electrodes which adjoin in the direction of a signal wire.

[0017]As for the invention according to claim 10, a projection is formed on an orienting film.

[0018]As for the invention according to claim 11, an orienting film on the second substrate of a portion whose projection exists is removed.

[0019]As for the invention according to claim 12, a slit is located in a center section of the picture element electrode at least.

[0020]

[Embodiment of the Invention]Hereafter, the 1st example that is an embodiment of the invention is described based on figures. The sectional view of a liquid crystal display when drawing 1 impresses the top view of the first substrate and drawing 2 is not impressing the electric field, and drawing 3 are the sectional views of a liquid crystal display when an electric field is impressed. Drawing 2 and drawing 3 are the sectional views which met the A-A line of drawing 1.

[0021]1 is the first substrate of a glass substrate and the scanning line 2 and the signal wire 3 are wired by matrix form on this first substrate 1. The field surrounded with the scanning line 2 and the signal wire 3 is equivalent to 1 pixel, the picture element electrode 4 is arranged in this field, and the thin film transistor 5 linked to the picture element electrode 4 is formed in the intersection of the scanning line 2 and the signal wire 3. As for the picture element electrode 4, a slit is formed in a center section and this slit has become a signal wire and parallel. 7 is the orienting film laminated by the signal wire 3 and the picture element electrode 4, and perpendicular orientation processing is performed.

[0022]8 is the second substrate of a glass substrate, on the second substrate 8, the black matrix 9 is formed so that each pixel may be divided, and the light filter 10 is laminated corresponding to each pixel. On the light filter 10, the common electrodes 11, such as ITO, are laminated and the orienting film 12 in which perpendicular orientation processing was performed on the common electrode 11 is laminated.

[0023]On the orienting film 12, the projection 13 of the conductor is formed at the position which counters the slit 6 and the signal wire 3 of the picture element electrode 4. Drawing 4 is a figure showing typically the physical relationship of the projection 13 and the picture element electrode 4, and as shown in drawing 4, each projection 13

is arranged in parallel. This projection 13 is formed with the same material as the common electrodes 11, such as ITO, and has become same electric potential mostly with the common electrode 11. Here, in order to make the projection 13 and the common electrode 11 into same electric potential, the projection 13 extended continuously to the end of the second substrate 8, the field where the orienting film 12 does not exist in the end of the second substrate 8 was provided, and the common electrode 11 is connected with the projection 13 in the field. The composition which does not limit to this gestalt if the projection 13 serves as the common electrode 11 to same electric potential mostly, and electrically connects the common electrode 11 with the projection 13 within the viewing area of the second substrate 8, and the composition which carries out direct supply of the common electrode 11 and the same voltage to the projection 13 may be used.

[0024]When forming a projection with the insulator of a lower dielectric constant, a projection is made to counter the picture element electrode 4, and is arranged, but when forming the projection 13 with a conductor, the projection 13 is made to counter the portion in which the picture element electrode 4 does not exist, and is arranged. This is because the direction on which the liquid crystal element 14 falls down by the projection of a lower dielectric constant and the projection 13 of a conductor since distribution of the electric field of the projection 13 neighborhood differs becomes reverse. Drawing 5 is a figure showing operation of the liquid crystal element 14 of the projection 13 neighborhood. Drawing 5 (a) shows the case where the projection 13a is a conductor, and drawing 5 (b) shows the time of the projection 13b being an insulator of a lower dielectric constant here. Permittivity anisotropy is negative, and when an electric field does not occur, vertical arrangement of the liquid crystal element 14 is carried out. Although the line of electric force A arises perpendicularly to the surface of the projection 13 at the time of the projection 13a of a conductor, the line of electric force B arises almost in parallel to the slant face of the projection 13b at the time of the projection 13b of a lower dielectric constant. And the liquid crystal element 14 will incline in the direction of the arrow shown in drawing 5, and it will be in a parallel condition mostly with the slant face of the projection 13a at the time of the projection 13a of a conductor, and will be in a perpendicular state mostly with the slant face of the projection 13b at the time of the projection 13b of a lower dielectric constant. Even when the projection 13a of a conductor is covered by the vertical orientation films 12, the liquid crystal element 14 carries out the same operation as the case where the projection 13a is not covered with the orienting film 12, but. The movement magnitude of the liquid crystal element 14 when an electric field is not impressed, in order for the liquid crystal element 14 to be influenced by the orienting film 12 and to arrange almost vertically to the slant face of the projection 13a, when an electric field is impressed becomes large, and since the array state of the liquid crystal element 14 changes, it will take time. Therefore, the direction which does not laminate the orienting film 12 on the projection 13a of a conductor changes to an array state with the liquid crystal element 14 certainly optimal in a short time at the time of impression of an electric field.

[0025]The projection 13 which countered the signal wire 3 is greatly formed a little rather than the projection 13 made to counter the slit 6. Although it is because this has the interval of the picture element electrode 4 which adjoins on both sides of the signal wire 3 larger than the width of the slit 6, each projection 13 may be made into the same size. What is necessary is for the height just to be 1 micrometers or more, when the width of the projection 13 is 10 micrometers, as it just inclines in the direction it was decided that the liquid crystal element 14 located in the projection 13 neighborhood with the line of electric force from the slant face of the projection 13 would be when the size of the projection 13 impresses an electric field, for example, shown in drawing 6.

[0026]Although the projection 13a is formed with the conductor in the 1st example, a projection may be formed with the dielectric which has a dielectric constant higher than the dielectric constant of a liquid crystal. In the projection of high permittivity, distribution of the electric field near a projection becomes closer to the state of the projection 13a of a conductor than the projection 13b of a lower dielectric constant, and falls on the slant face of a projection, and parallel like [operation of the liquid crystal element 14 near a projection] the time of the projection 13a of a conductor.

[0027]Among both the substrates 1 and 8, a liquid crystal negative in permittivity anisotropy is enclosed, and when not impressing voltage to the picture element electrode 4, as the liquid crystal element 14 shows drawing 2, vertical arrangement is carried out in response to the influence of the vertical orientation films 7 and 12. At this time, although the projection 13 is not covered with the orienting film 12, the liquid crystal element 14 of the projection 13 neighborhood is influenced by the array state of the adjoining liquid crystal element 14, and carries out vertical arrangement of it. Both the substrates 1 and 8 are put with the polarizing plate of the couple which is not illustrated, and when it has arranged so that the transmission axis of the polarizing plate may intersect perpendicularly, the transmitted light which passed one polarizing plate passes a liquid crystal layer, without carrying out a double reflex with the liquid crystal element 14, and is intercepted with the polarizing plate of another side.

[0028]When voltage is impressed to the picture element electrode 4, as it is shown in drawing 3, an electric field occurs between the picture element electrode 4 and the common electrode 11. The dotted line of drawing 3 shows line of electric force. Since the projections 13 are the common electrode 11 and same electric potential at this time, an electric field occurs perpendicularly to the surface of the projection 13, and the liquid crystal element 14 of the projection 13 neighborhood inclines so that an electric field flux line and that major axis may cross at right angles. When it observes in the section shown in drawing 3, an electric field occurs toward the slanting upper part from the end of the picture element electrode 4, and the liquid crystal element 14 near the end of the picture element electrode 4 inclines so that the line of electric force from an end and the major axis may cross at right angles. At this time, the liquid crystal element 14 of the projection 13 neighborhood and the liquid crystal element 14 near the end of the picture element electrode 4 incline in a uniform direction, and the liquid crystal element 14 which adjoins

in response to the influence of this inclined liquid crystal element 14 also inclines in a uniform direction. If it arranges so that it may not become the major axis direction of the liquid crystal element 14 and parallel which inclined the transmission axis of the polarizing plate of a couple, with the liquid crystal element 14, the double reflex of the transmitted light which passed one polarizing plate will be carried out, and it will pass the polarizing plate of another side. Since an operation of the double reflex by the liquid crystal element 14 becomes the largest when the transmission axis of a polarizing plate is leaned 45 degrees and has been arranged to the major axis direction of this inclined liquid crystal element 14, a white display can be performed efficiently. Since the liquid crystal element 14 inclines almost in parallel with the slant face of the projection 13, the slope direction of the liquid crystal element 14 becomes reverse bordering on the projection 13. Therefore, in a pixel, several domains where the slope directions of the liquid crystal element 14 differ exist, and the view angle characteristic is compensated mutually.

[0029] Thus, since the projection of the conductor was provided, though it is the composition of generating two or more domains in a pixel, a voltage drop can be prevented and impurity ion can be prevented from focusing and adhering.

[0030] Next, the 2nd example is described based on drawing 7. Drawing 7 is a mimetic diagram showing the physical relationship of the picture element electrode 4 and the projection 16, and is carrying out the same composition as the 1st example except the slit 15 of the picture element electrode 4, and the shape of the projection 16. The slit 15 parallel to the scanning line 2 is formed in the center portion of this picture element electrode 4, and the projection 16 is formed in the slit 15 and the scanning line 2, and the position that counters. This projection 16 is also formed on the orienting film 12 with a conductor, and is electrically connected with the common electrode 11 in the portion in which it extends continuously to the end of the second substrate 8, and the orienting film 12 does not exist. And if an electric field occurs between the picture element electrode 4 and the common electrode 11, bordering on the projection 16, the liquid crystal element 14 will incline to an opposite direction, and will form two or more domains in a pixel.

[0031] Next, the 3rd example is described based on drawing 8. Drawing 8 is a mimetic diagram showing the physical relationship of the picture element electrode 4 and the projection 18, and is carrying out the same composition as the 1st example except the slit 17 of the picture element electrode 4, and the shape of the projection 18. The projection 18 of this conductor was formed in zigzag shape, and has extended continuously to the end of the second substrate 8 along the signal wire 3. The projection 18 has been arranged ranging over the two picture element electrodes 4 which adjoin a scanning line 2-way, and each projection 18 is located in a line in parallel. The slit 17 is formed in the position which corresponds to the picture element electrode 4 with the projection 18. And if an electric field occurs between the picture element electrode 4 and the common electrode 11, bordering on the projection 18, the liquid crystal element 14 will incline to an opposite direction, and will form two or more domains in a pixel. If 1 pixel is observed at this time, in 1 pixel, the projection 18a of two sides located in a line in parallel and the projection 18b of two sides mutually located in a line in parallel toward a different direction from that projection 18a exist. That is, in order for 2 sets of projections 18a and 18b which were suitable in the direction which is different in 1 pixel, respectively to exist, and for the liquid crystal element 14 to incline to an opposite direction among 1 set each of projections 18 and to form two domains, Four domains can be formed in 1 pixel and a wide viewing angle liquid crystal display can be realized.

[0032] Although the projection 18 has been arranged along the signal wire 3 in this example, the composition arranged along the scanning line 2 may be used. In that case, a projection is arranged ranging over the two picture element electrodes 4 which adjoin each other in the signal wire 3 direction, and each projection is put in order in parallel.

[0033] Next, the 4th example is described based on drawing 9. Drawing 9 is a sectional view of a liquid crystal display, and corresponds to drawing 2 of the 1st example. Although the 4th example differs in the method of connection the 1st example, the common electrode 11, and the projection 19, other composition is the same as the 1st example. The 4th example forms the projection 19 of a conductor on the common electrode 11 except for the orienting film 12 of a portion in which the projection 19 is located. Since the projection 19 can connect with the common electrode 11 certainly at this time, the projection 19 becomes the common electrode 11 and same electric potential. After forming the common electrode 11 on the second substrate 8, the orienting film 12 is laminated, only the portion in which the projection 19 is located removes the orienting film 12, and the method of formation this projection 19 forms the projection 19 after that. In this case, in consideration of the mask gap at the time of forming projection 19 grade, it is necessary to remove the orienting film 12 widely a little. As the method of other formation, the projection 19 is previously formed on the common electrode 11, and after covering the common electrode 11 and the projection 19 with the orienting film 12, only the portion of the projection 19 may remove the orienting film 12. Since the projection 19 is certainly connected to the common electrode 11 regardless of the laminating condition of the orienting film 12 and a proper-shaped thing can be formed at this time, the portion which removes the orienting film 12 can be made into the minimum. For a touching [all the projections 19]-common electrode 11 reason, although arranged corresponding to the slit 6 and the signal wire 3 of the picture element electrode 4, this projection 19 may not be made to extend continuously to the end of the second substrate 8, or it may divide selectively and it may be provided. And when voltage is impressed to the picture element electrode 4, the liquid crystal element 14 of the projection 19 neighborhood operates like the 1st example, and forms two or more domains in 1 pixel.

[0034] Since the projection was formed in the common electrode side by this invention as mentioned above, when an electric field occurs between a picture element electrode and a common electrode, two or more domains can be

formed in each pixel, and a wide viewing angle liquid crystal display is made. Since the projection is furthermore formed with the conductor, a projection becomes a common electrode and same electric potential, the voltage drop produced when impurity ion can be prevented from sticking to a projection intensively and the projection of a lower dielectric constant exists in the part in a pixel can be prevented, and a uniform electric field is generated between a picture element electrode and a common electrode — things can be carried out.

[0035]In the case of the projection of a conductor, the example explained, but a projection may be formed with the dielectric which has a dielectric constant higher than the dielectric constant of a liquid crystal, and the same effect as the projection of a conductor can be acquired also in this case. In the projection of this invention, it is also possible for a projection to counter near the end of a picture element electrode, to just be arranged, and to take gestalten other than an example.

[0036]

[Effect of the Invention]According to this invention, even when a projection is provided so that two or more domains may be formed in a pixel, it can reduce that impurity ion adheres to a projection intensively, and a phenomenon can be prevented for printing. The voltage drop resulting from a projection can be decreased and a good display can be obtained.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a top view of the first substrate of the liquid crystal display which is the 1st example of this invention.

[Drawing 2]It is a sectional view of a liquid crystal display when not impressing the electric field.

[Drawing 3]It is a sectional view of a liquid crystal display when an electric field is impressed.

[Drawing 4]It is a mimetic diagram showing the physical relationship of the picture element electrode of a liquid crystal device and projection which are the 1st example.

[Drawing 5]It is a figure explaining operation of the liquid crystal element located near the projection at the time of impressing voltage.

[Drawing 6]It is an expanded sectional view of a projection of the 1st example.

[Drawing 7]It is a mimetic diagram showing the physical relationship of the picture element electrode of a liquid crystal display and projection which are the 2nd example.

[Drawing 8]It is a mimetic diagram showing the physical relationship of the picture element electrode of a liquid crystal display and projection which are the 3rd example.

[Drawing 9]It is a sectional view when not impressing the electric field of the liquid crystal display which is the 4th example.

[Description of Notations]

- 1 The first substrate
- 2 Scanning line
- 3 Signal wire
- 4 Picture element electrode
- 6, 15, and 17 Slit
- 7 and 12 Orienting film
- 8 The second substrate
- 11 Common electrode
- 13, 16, 18, and 19 Projection
- 14 Liquid crystal element

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(5) Int. Cl. G 0 2 F 1/1343 1/1337	FI G 0 2 F 1/1343 1/1337	5 2 0 5 2 0	テコト (参考) 2 H 0 9 0 2 H 0 9 2
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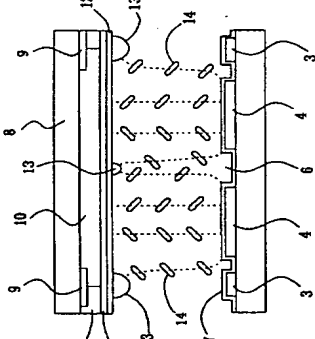
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(54) 発明の名称 液晶表示装置

(57) 要約

【目的】 横付き現象等の表示ムラを防止すると共に、1画素内に複数のドメインを形成した広視野角の液晶表示装置を提供することを目的とする。

【構成】 面素電極4を有する第一基板1と共通電極1を有する第二基板8を対向配置し、両基板1、8間に誘電率異方性が負の液晶14を挟持する。両基板1、8を垂直配向し、1、2で覆い、液晶層に電界が印加されないときは液晶分子14が垂直配列し、液晶層に電界が印加されたときは液晶分子14が傾斜して配列する液晶表示装置において、第二基板8に電界印加時の液晶分子14の傾斜方向を規制する導電体の突起13を設け、面素電極4には突起13と対向する部分にスリット6を形成する。



最終頁に続く

【請求項10】 前記突起が前記配向膜上に形成されていることを特徴とする請求項1乃至請求項9記載の液晶表示装置。

【請求項11】 前記突起が存在する部分は前記第二基板上の配向膜が除去されていることを特徴とする請求項1乃至請求項10記載の液晶表示装置。

【請求項12】 前記スリットが少なくとも前記面素電極の中央部に位置することを特徴とする請求項1乃至請求項11記載の液晶表示装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は1画素内に複数のドメインを設けた広視野角の液晶表示装置に関する。

【0002】

【従来の技術】 一般に液晶表示装置には薄型軽量、低消費電力という特徴があり、携帯電話から大型テレビに至るまで幅広く利用されている。この液晶表示装置としてTN型の液晶表示装置がよく使われ、表示装置として高い性能、品質を維持している。

【0003】 TN型のTFT (Thin Film Transistor) 液晶表示装置の場合、面素電極が形成された基板と共通電極が形成された基板を対向するように配置し、この二つの基板間に液晶を封入している。両基板上の配向膜はラビング等によって配向処理が行われ、その配向方向は対向する基板の配向方向と90度異なるように設定されている。液晶分子はこの配向方向に規制されてその方向に水平配列し、基板間では水平方向に90度傾いて配列する。各基板の外側には偏光板が基板に対向して配置されるが、ノーマリブラックモードのときは両偏光板の透過軸が同一方向になるように配置され、ノーマリホワイトモードのときは両偏光板の透過軸が90度異なるように配置される。一方の偏光板を透過した透過光は偏光線偏光となった液晶層を通過するが、このとき液晶分子は90度傾いて配列しているの透過光は偏光線偏光とならずに透過光は透過光として透過する。一方の偏光板を透過した透過光は偏光線偏光となった液晶層を通過するが、このとき液晶分子は90度傾いて配列しているの透過光は偏光線偏光とならずに透過光として透過する。

【0004】 しかしTN型液晶表示装置等は視野角低減性が大きい等の問題があった。そこでTN型よりも広視野角なIPS (In-Plane Switching) 型やVA (Vertically Aligned) 型の液晶表示装置が提案されている。VA型の液晶表示装置は、一方の基板には面素電極が、他方の基板には共通電極が配置されている。両基板の配向膜には共通配向処理が施され、電極に電圧を印加しないときは液晶分子が垂直配列している。両基板の外側には偏光板が配置され、両偏光板の透過軸が直交するように設定されている。そして電極に電圧を印加していないとき

は基板間の液晶分子が垂直配列しているもので、一方の偏光板を通して直線偏光の透過光がそのままだ液晶層を通過して他方の偏光板によって歪められる。また電極に電圧を印加したときは基板間の液晶分子が水平配列するので、一方の偏光板を通過した直線偏光の透過光は液晶層を通過するときには基板間の液晶分子が水平偏光の透過光になり、他方の偏光板を通過する。

【0005】こうした液晶表示装置の視野角を更に改善するために、1画素内に複数のドメインを形成する方法があり、このドメインを形成するために画素内に突起や溝を設けている。これは例えば特許第2947350号公報に記載されている。例えば、他方の基板側に突起を設ける場合、他方の基板にブラックマトリックスとカラーフィルタを形成し、カラーフィルタ等を共通電極で覆っている。この共通電極上に固定パターン突起を形成して、共通電極及び突起に配向膜を積層している。この突起は低誘電率性の絶縁物である誘電体で形成されている。

【0006】【発明が解決しようとする課題】しかし画素内に突起を設ける場合、画素電極と共通電極の間に突起が存在することになるが、その突起が低誘電体の絶縁体で形成されることがあるため、この突起によって液晶層に印加された電圧が低下する。また、液晶層には不純物イオンが浮遊しているが、共通電極上に低誘電性の突起が存在する場合は不純物イオンがその突起に集中して付着してしまい、表示の残像現象が発生する。このように突起が原因となっていて表示不良が生じてしまう。

【0007】そこで本発明は、残像等の表示ムラを防止すると共に、1画素内に複数のドメインを形成した広視野角の液晶表示装置を提供することを目的とする。

【0008】【課題を解決するための手段】上記課題を解決するためには請求項1記載の発明は、信号線と走査線をマトリクス状に配置し、信号線と走査線とで囲まれる画素内に画素電極を形成した第一基板と、共通電極を形成した第二基板と、両基板間に積層される垂直配向処理を施した配向膜と、両基板間に保持される誘電率異なる液体を有し、液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、第二基板に傾斜して配列する液晶分子の傾斜方向を規制する導電板に設けられ且つ液晶分子の傾斜方向を規制する導電板の端部まで連続的に延在し、端部で共通電極と電気的に接続されることを特徴とする。

【0009】また請求項4記載の発明は、信号線と走査線とをマトリクス状に配置し、信号線と走査線とで囲まれる第一基板と、第二基板と、両基板間に積層される誘電率異なる液体を有し、液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、第二基板に傾斜して配列する液晶分子の傾斜方向を規制する導電板に設けられ且つ液晶分子の傾斜方向を規制する導電板の端部まで連続的に延在し、端部で共通電極と電気的に接続されることを特徴とする。

【0010】また請求項5記載の発明は、信号線と走査線とをマトリクス状に配置し、信号線と走査線とで囲まれる第一基板と、第二基板と、両基板間に積層される誘電率異なる液体を有し、液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、第二基板に傾斜して配列する液晶分子の傾斜方向を規制する導電板に設けられ且つ液晶分子の傾斜方向を規制する導電板の端部まで連続的に延在し、端部で共通電極と電気的に接続されることを特徴とする。

【0011】また請求項6記載の発明は、信号線と走査線とをマトリクス状に配置し、信号線と走査線とで囲まれる第一基板と、第二基板と、両基板間に積層される誘電率異なる液体を有し、液晶層に電界が印加されたときは液晶分子が傾斜して配列する液晶表示装置において、第二基板に傾斜して配列する液晶分子の傾斜方向を規制する導電板に設けられ且つ液晶分子の傾斜方向を規制する導電板の端部まで連続的に延在し、端部で共通電極と電気的に接続されることを特徴とする。

【0012】また請求項7記載の発明は、突起がジグザグ状に形成されていることを特徴とする。

【0013】また請求項8記載の発明は、突起が直線状に形成されていることを特徴とする。

【0014】また請求項9記載の発明は、突起が直線状に形成されていることを特徴とする。

【0015】また請求項10記載の発明は、突起が直線状に形成されていることを特徴とする。

【0016】また請求項11記載の発明は、突起が直線状に形成されていることを特徴とする。

【0017】また請求項12記載の発明は、突起が直線状に形成されていることを特徴とする。

【0018】また請求項13記載の発明は、突起が直線状に形成されていることを特徴とする。

【0019】また請求項14記載の発明は、突起が直線状に形成されていることを特徴とする。

【0020】また請求項15記載の発明は、突起が直線状に形成されていることを特徴とする。

【0021】また請求項16記載の発明は、突起が直線状に形成されていることを特徴とする。

【0022】また請求項17記載の発明は、突起が直線状に形成されていることを特徴とする。

【0023】また請求項18記載の発明は、突起が直線状に形成されていることを特徴とする。

【0024】また請求項19記載の発明は、突起が直線状に形成されていることを特徴とする。

【0025】また請求項20記載の発明は、突起が直線状に形成されていることを特徴とする。

【0026】また請求項21記載の発明は、突起が直線状に形成されていることを特徴とする。

【0027】また請求項22記載の発明は、突起が直線状に形成されていることを特徴とする。

【0028】また請求項23記載の発明は、突起が直線状に形成されていることを特徴とする。

【0029】また請求項24記載の発明は、突起が直線状に形成されていることを特徴とする。

【0030】また請求項25記載の発明は、突起が直線状に形成されていることを特徴とする。

【0031】また請求項26記載の発明は、突起が直線状に形成されていることを特徴とする。

【0032】また請求項27記載の発明は、突起が直線状に形成されていることを特徴とする。

【0033】また請求項28記載の発明は、突起が直線状に形成されていることを特徴とする。

【0034】また請求項29記載の発明は、突起が直線状に形成されていることを特徴とする。

【0035】また請求項30記載の発明は、突起が直線状に形成されていることを特徴とする。

【0036】また請求項31記載の発明は、突起が直線状に形成されていることを特徴とする。

【0037】また請求項32記載の発明は、突起が直線状に形成されていることを特徴とする。

【0038】また請求項33記載の発明は、突起が直線状に形成されていることを特徴とする。

【0039】また請求項34記載の発明は、突起が直線状に形成されていることを特徴とする。

【0040】また請求項35記載の発明は、突起が直線状に形成されていることを特徴とする。

【0041】また請求項36記載の発明は、突起が直線状に形成されていることを特徴とする。

【0042】また請求項37記載の発明は、突起が直線状に形成されていることを特徴とする。

【0043】また請求項38記載の発明は、突起が直線状に形成されていることを特徴とする。

【0044】また請求項39記載の発明は、突起が直線状に形成されていることを特徴とする。

【0045】また請求項40記載の発明は、突起が直線状に形成されていることを特徴とする。

【0046】また請求項41記載の発明は、突起が直線状に形成されていることを特徴とする。

【0047】また請求項42記載の発明は、突起が直線状に形成されていることを特徴とする。

【0048】また請求項43記載の発明は、突起が直線状に形成されていることを特徴とする。

【0049】また請求項44記載の発明は、突起が直線状に形成されていることを特徴とする。

【0050】また請求項45記載の発明は、突起が直線状に形成されていることを特徴とする。

【0051】また請求項46記載の発明は、突起が直線状に形成されていることを特徴とする。

【0052】また請求項47記載の発明は、突起が直線状に形成されていることを特徴とする。

【0053】また請求項48記載の発明は、突起が直線状に形成されていることを特徴とする。

インが存在し、互いに導電性を補償し合っている。
 【0029】このように導電体の突起を設けたので、画素内に複数のドメインを発生させる構成でありながら、電圧降下を防止でき且つ不純物イオンが集中して付着することを防止できる。

【0030】次に第2実施例を図7に基づいて説明する。図7は画素電極4と突起16との位置関係を示す模式図であり、画素電極4のスリット15と突起16の形状以外には第1実施例と同じ構成をしている。この画素電極4の中央部分に走査線2と平行なスリット15が形成され、突起16はスリット15及び走査線2と対向する位置に形成される。この突起16も導電体で構成され、突起16の端部まで連続的に延在して上形成され、第二基板8の端部まで連続的に延在して配向膜12の存在しない部分で共通電極11と電気的に接続されている。そして画素電極4と共通電極11の間に電界が発生すると突起16を境にして液晶分子14が逆方向に傾斜し、画素内に複数のドメインを形成する。

【0031】次に第3実施例を図8に基づいて説明する。図8は画素電極4と突起18との位置関係を示す模式図であり、画素電極4のスリット17と突起18の形状以外には第1実施例と同じ構成をしている。この導電体の突起18はジグザグ状に形成され、番号線3に沿って第二基板8の端まで連続的に延在している。また突起18は走査線2方向に斜り合う2つの画素電極4にまたがって配置され、各突起18は平行に並んでいる。画素電極4には突起18と対応する位置にスリット17が形成されている。そして画素電極4と共通電極11の間に電界が発生すると突起18を境にして液晶分子14が逆方向に傾斜し、画素内に複数のドメインを形成する。このとき1画素を觀察すると、1画素内には平行に並んだ2本の突起18aと、その突起18aと異なる方向に向き且つ互いに平行に並んだ2本の突起18bが存在する。つまり1画素内にそれぞれ異なる方向に向いた2組の突起18a、18bが存在することになり、各1組の突起18の間に液晶分子14が逆方向に傾斜して2つのドメインを形成するため、1画素内に4つのドメインを形成することができ、広視野角な液晶表示装置を実現できる。

【0032】この実施例では突起18を番号線3に沿って配置したが、走査線2に沿って配置する構成でもいい。その場合、突起は番号線3方向に斜り合う2つの画素電極4にまたがって配置され、各突起は平行に並べられる。

【0033】次に第4実施例を図9に基づいて説明する。図9は液晶表示装置の断面図であり、第1実施例の図2に対応する。第4実施例は第1実施例と共通電極11と突起19の接続の仕方が異なるが、その他の構成は第1実施例と同じである。第4実施例は突起19が位置する部分の配向膜12を除き、共通電極11上に導電体の突起19を形成している。このとき突起19が溝裏に

共通電極11に接続できるため、突起19が共通電極11と同電位になる。この突起19の形成の仕方は、第二基板8上に共通電極11を形成した後配向膜12を積層し、突起19が位置する部分だけ配向膜12を除き、その後突起19を形成する。この場合、突起19等を形成する際のマスクずれを考慮して、若干広配向膜12を除く必要がある。他の形成の仕方として、共通電極11上に先に突起19を形成し、共通電極11及び突起19を配向膜12で覆った後に突起19の部分のみ配向膜12を除き、このとき配向膜12の積層状態に関係なく、突起19は確実に共通電極11に接続され、且つ適正な形状のもの形成できるため、配向膜12を除く部分を最小限にすることができ、この突起19は画素電極4のスリット6及び番号線3に対応して配置されるが、全ての突起19が共通電極11に接続しているため、第二基板8の端部まで連続的に延在させなくても部分的に分割して設けても良い。そして画素電極4に電圧を印加したときは突起19付近の液晶分子14は第1実施例と同様に動作し、1画素内に複数のドメインを形成する。

【0034】以上のように本発明では共通電極側に突起を形成したので、画素電極と共通電極の間に電界が発生した際に各画素内に複数のドメインを形成することができ、広視野角な液晶表示装置ができ、さらに突起を導電体で形成していることで突起が共通電極と同電位になり、不純物イオンが突起に集中的に吸着することを防止でき、また画素内の一部分に低電圧の突起が存在するときに生じる電圧降下を防止でき、画素電極と共通電極の間に均一な電界を発生させることができる。

【0035】なお、実施例では導電体の突起の場合で説明したが、突起を液晶の誘電率より高い誘電率を有する誘電体で形成してもよく、この場合も導電体の突起と同じ効果を得られる。また、本発明の突起の場合、突起は画素電極の端部付近に対向して配置されればよく、実施例以外の形態を取ることも可能である。

【0036】

【発明の効果】本発明によれば、画素内に複数のドメインを形成するように突起を設けた場合でも、突起に不純物イオンが集中的に付着することを低減でき、焼付き現象を防止できる。また突起に起因する電圧降下を減少させることができ、良好な表示を得ることができる。

【図面の簡単な説明】

【図1】本発明の第1実施例である液晶表示装置の第一基板の平面図である。

【図2】電界を印加していないときの液晶表示装置の断面図である。

【図3】電界を印加したときの液晶表示装置の断面図である。

【図4】第1実施例である液晶表示装置の画素電極と突起との位置関係を示した模式図である。

【図5】電圧を印加した際の突起付近に位置する液晶分子の動作を説明する図である。

【図6】第1実施例の突起の拡大断面図である。

【図7】第2実施例を示した模式図である。

【図8】第3実施例である液晶表示装置の画素電極と突起との位置関係を示した模式図である。

【図9】第4実施例である液晶表示装置の電界を印加していないときの断面図である。

【符号の説明】

1 第一基板

2 走査線

3 番号線

4 画素電極

6、15、17 スリット

7、12 配向膜

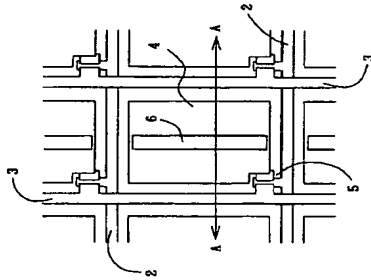
8 第二基板

11 共通電極

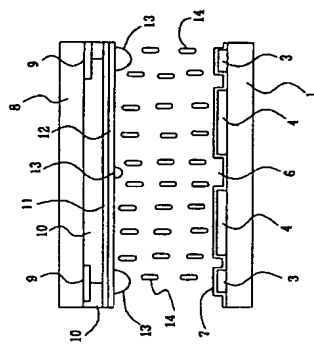
13、16、18、19 突起

10 14 液晶分子

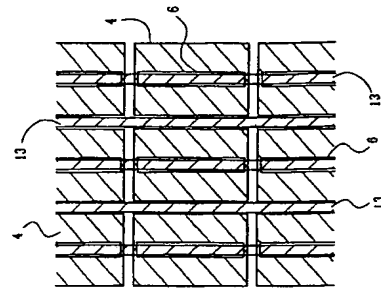
【図1】



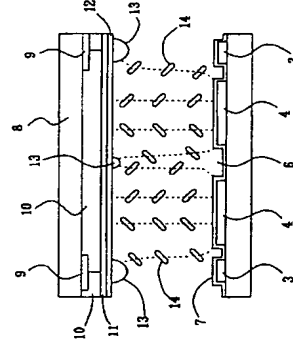
【図2】

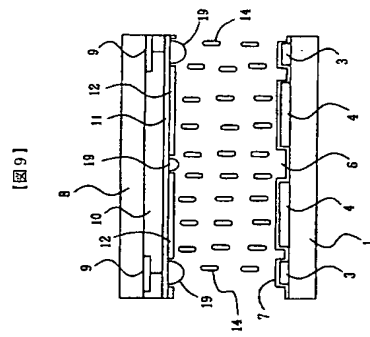
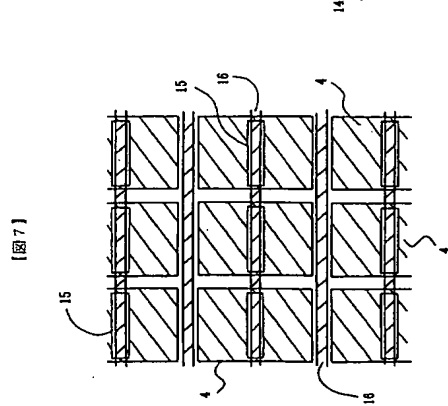
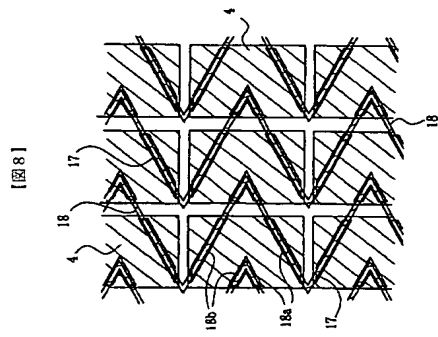
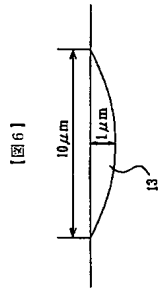
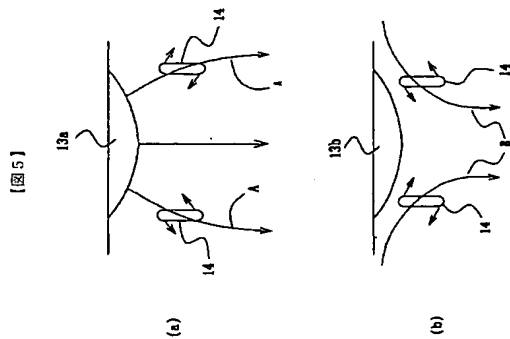


【図4】



【図3】





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Fターム(参考) 2H090 KA05 LA01 LA04 MA01 MA15
2H092 GA13 HA03 JA24 JB52 MA01
PA08 PA11 QA07

フロントページの続き

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